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EVALUATION OF LONGEVITY AND SPREAD OF ANNOSUS ROOT ROT IN THE BLM'S IDAHO CITY PONDEROSA PINE TREE IMPROVEMENT PLANTATION

by

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ABSTRACT

The root/butt rot fungus, Fomes annosus, was detected killing ponderosa pine in a BLM ponderosa pine plantation in 1972. In 1976 a survey was conducted to identify and map areas of the plantation with F. annosus activity and to install permanent plots for monitoring the spread of identified disease centers. Thirty-four centers were identified in 1976 and the rate of spread was estimated to be 1.7 feet/year. These plots were revisited in 1981-1982 to monitor the mortality and spread rates in the permanent plots. The following is a progress report of the results to date.

INTRODUCTION

The Bureau of Land Management's (BLM) Boise District established a ponderosa pine plantation near Idaho City in 1966 as part of a long-term, multi-plantation tree improvement program for ponderosa pine. Six years after establishment, the root/butt rotting fungus, Fomes annosus (Fr.) Cke., was detected killing trees (5) and was considered a potential threat to the success of the plantation.

In 1976, former Regional Plant Pathologist Al Tegethoff and others surveyed the entire area to locate F. annosus centers within and immediately adjacent to the plantation. Infection centers were defined as single-to-grouped pine mortality adjacent to field-determined F. annosus - infected ponderosa pine stumps. Azimuth and distance from the apparent infection source, i.e., stump, were measured and plotted on a map. All other dead trees not identified as killed by F. annosus were also plotted on the map, but labeled as "unknown mortality."

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EXPERIMENT STATION

During 1981-1982, we re-evaluated these infection centers to monitor the spread of F. annosus. All trees which had died since 1976 were examined for signs or symptoms of F. annosus infection. Locations of all infected trees were measured as in 1976 and added to the 1976 plot maps.

Site Description

The 14 acre plantation is located in Sec. 27, T.6N., R.5E, BM near Idaho City, Idaho. It is situated on a generally southeast-facing, 15-20 percent slope of between 3,900 and 4,000 feet in elevation. A brief soil survey 1/ in the area indicated that in northern (upslope) portions of the plantation, soils are generally composed of 6-10 inches of coarse sandy to sandy loam over a very compacted sandy clay loam to about 36 inches in depth. Soils in the southern portion (downslope) of the plantation are generally composed of 6-8 inches of coarse sandy to sandy loam grading to a sandy loam 2-5 feet in depth.

Management History

The area was clearcut during the winter and spring of 1966. Based on a residual stump count, 105 ponderosa pine were removed. Average stump diameter estimated from 1982 stump measurements was 20-21 inches (inside bark diameter). Stump locations are plotted in Fig. 1.

In 1966, 2-0 ponderosa pine seedlings of various parentage and grown at the Intermountain Region's Lucky Peak Forest Nursery were planted at 5 foot intervals in rows 10 feet apart.

Following is an update pertaining to the current status of infection centers in the plantation.

RESULTS UPDATE AND DISCUSSION

During the 1976 survey, 34 Fomes annosus centers were identified and mapped (Fig. 1). Between 1966 and the 1976 survey, 63 ponderosa pine had died from F. annosus infections. Many other dead trees were noted, however, F. annosus was not identified as being the causal agent. Most of this mortality was attributed to pocket gophers.

Re-evaluation of the area in 1981-1982 revealed 30 additional trees had died from F. annosus infections since 1976. The majority of these (24 of 30), based on lack of needle retention and sloughed bark, apparently died prior to 1980. We estimate that annual F. annosus-related mortality has decreased from 7-9 trees per year (1976 estimate) to only 2 trees per year (1982 survey) over the entire plantation. The mortality rate estimate through 1976 is based on reports indicating mortality may first be noted from 1-3 years following cutting operations (3,4). We are assuming the

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1/ Soil survey evaluation by Larry Rasmussen, Soil Scientist, USDA Soil Conservation Service, Boise, Idaho.

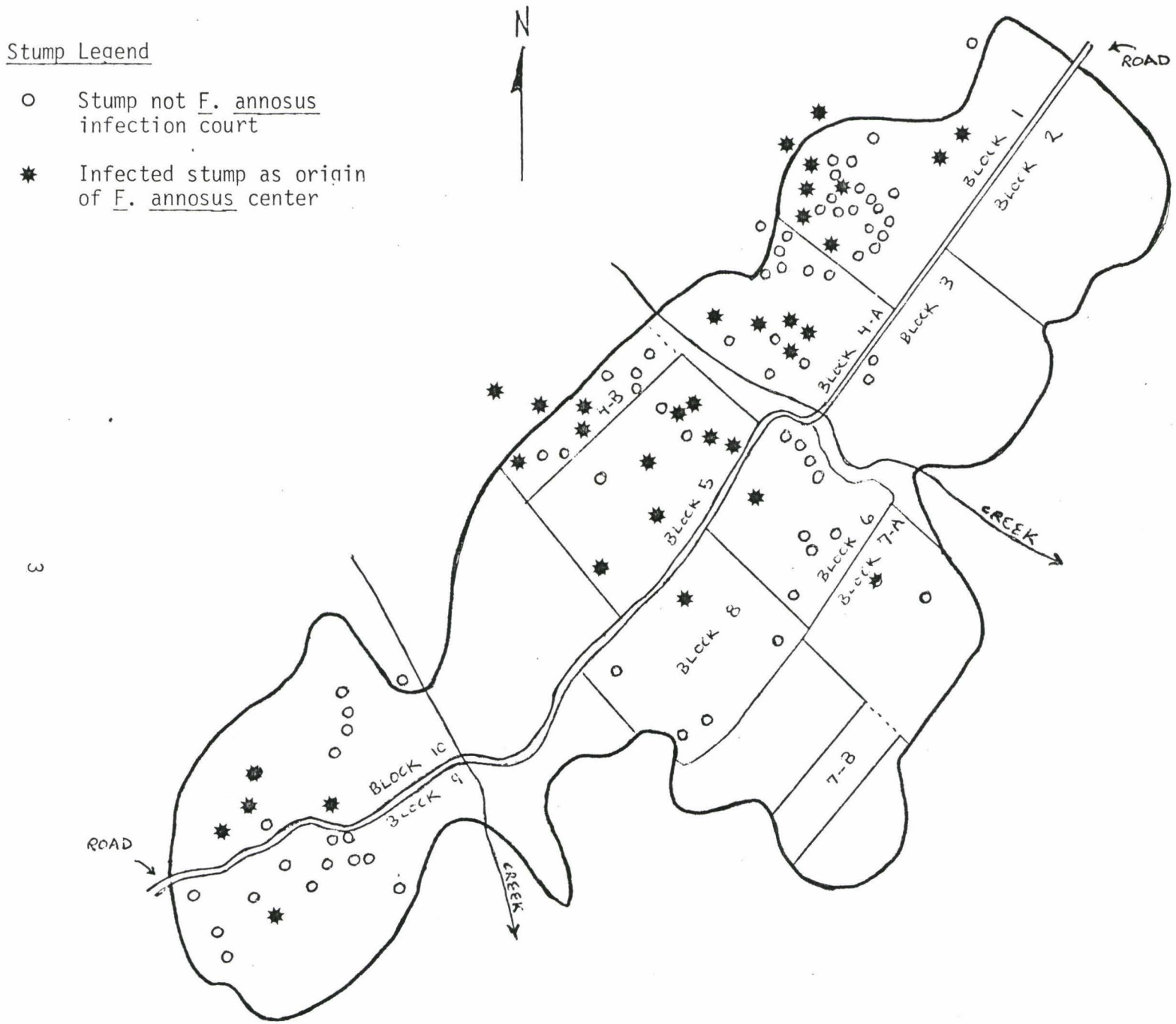

Figure 1. A BLM ponderosa pine plantation near Idaho City, Idaho. Each circle or star represents an existing ponderosa pine stump created by the 1966 clearcut. Stars represent stumps which served as epicenters for Fomes annosus disease centers.

BLM's initial F. annosus-caused mortality occured somewhere between 1967 and 1969.

The rate of spread for the average disease center also seems to have declined over the years. We estimated the rate of spread per year by: (1) dividing each disease center into quadrants (NE, NW, SW, SE), (2) calculating the average distance of visibly infected trees from plot center for each quadrant having F. annosus-infected trees, (3) averaging the quadrant averages, and (4) dividing that average by the number of years since clearcutting. A similar method to estimate disease center spread rate was used by Cobb et al. (1).

The average spread rate between 1966 and 1976, as calculated above, was 1.8 ft/yr. Between 1976 and 1982 average disease center spread increased by only 11 inches. In 14 of the 34 plots no F. annosus activity since 1976 was noted. Perhaps the apparent decline in fungus activity is due to increasing resistance of trees as they become older (4) and/or to the depletion of inoculum reserves. We suspect the frequency of mortality caused by this fungus will continue to decline throughout the plantation. Area currently occupied by each F. annosus infection center was calculated using the mean average quadrant radius for that center. The area occupied by these centers ranges from 15 square feet to 935 square feet and averages 197 square feet per center. Overall, F. annosus infection centers occupy 1.2 percent of the original 14 acre site. Assuming some of the dead trees identified as "unknown mortality" probably died from F. annosus infections, the percentage of area attributed to disease centers could be slightly higher than 1.2 percent.

In forest stands managed for wood production, small infection centers may be beneficial to management unless desirable species or individuals are selectively attacked. However, when openings become so large that the growing space is not utilized, impaired production may result. Size of openings resulting in impairment may vary by site, but the larger F. annosus infection centers noted in these evaluations surely impair fiber production.

A correlation between the ability of stumps to function as infection courts and the combined influence of soils and topography seems to exist. Above or north of the road bisecting the plantation (Fig. 1) slopes are steeper and soils are more droughthy than those below the road. Of the 74 stumps located above the road, disease centers originated from 41 percent of the stumps. Below the road, disease centers originated from only 13 percent of the stumps.

Research in the southeast (3) associates site hazard with soil texture and drainage. In general, well-drained, deep sandy soils are considered high hazard, and soils with poor drainage or the combination of good surface drainage and clay within 12 inches of the surface are considered low hazard. Based on these criteria, soils at the BLM plantation could be considered low-to-moderate in hazard. However, hazard estimates for the BLM plantation are based on a limited number of soil profile pits, and further data regarding soil disease occurance relationships need to be collected and evaluated to develop accurate hazard ratings.

Table 1. Percent of stumps, by diameter groupings, initiating disease centers. Only stumps with known diameters are included.[1]

Diameter Range of Stumps	No. of Stumps	No. of Disease Center Stumps	% Creating Disease Centers
9.0 - 12.9 in.	5	1	20 %
13.0 - 16.9 in.	20	4	20 %
17.0 - 20.9 in.	30	7	23 %
21.0 - 24.9 in.	21	8	38 %
25.0 - 28.9 in.	14	7	50 %
29.0 - 32.9 in.	5	2	40 %
33.0 - 36.9 in.	4	0	0 %
TOTAL [2]	99	29	29 %
ACTUAL TOTAL [3]	105	34	32 %

[1] Six stumps were not measured due to partial deterioration of stumps. However, their sizes appeared to be representative of the others.

[2] Total of stumps with known diameters

[3] Total of stumps including the six with unknown diameters.

Over the entire plantation disease centers originated from 32 percent of the stumps exposed in 1966. Although the number of stumps from which infection centers originated is relatively high, the percentage of stumps initially infected after clearcutting is presumably much higher as some of the initial infections likely succumb to competitive saprophytic fungi and adverse environmental conditions (2,4). This suggests that inoculum levels may be very high or that environmental conditions favoring infection exist during certain periods. During these periods, either stumps should not be exposed, or exposed stumps should be treated to prevent infection.

Stump size did not seem to affect infection center initiation. The average diameter of stumps initiating disease centers was 22.3 inches with a range of 11-31 inches. When stumps were grouped into 4-inch classes (i.e., 9.0-12.9, 13.0-16.9, etc.), all but the 33.0-36.9 inch class had at least 20 percent of the stumps initiating disease centers (Table 1.).

Stumps less than 9 inches in diameter were not observed in the plantation, probably due to one of the following two reasons: (1) either no trees were cut in that category, or (2) if any were cut, the stumps did not remain intact for very long. Observations in nearby plantations on the Boise National Forest suggest that stumps up to 6-8 inches in diameter deteriorate within 5 years, 2/ and thus may function infrequently to develope infection centers.

Stumps seem to be the major means of F. annosus disease center initiation and serve as inoculum reservoirs. However, we observed F. annosus sporophores on bitterbrush (Purshia tridentata (Pursh) DC.) and suspect that it and possibly other shrubs may function in the same manner. Tegethoff (5) has reported similar observations in nearby areas.

PROJECT CONTINUATION

Until it is apparent that disease centers are no longer active, the plantation will be visited every three years to monitor the spread of Fomes annosus. At project's end, we hope to identify:

1. Number of trees killed.
2. The change in the rate of spread over time.
3. The average size of disease center openings.
4. Amount of area infected with F. annosus.
5. The effect of disease center openings on forest productivity.
6. Site associations with F. annosus disease centers.

2/ Observations by Phil Straub, Silviculturist, USDA, Forest Service, Boise National Forest.

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